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ENGELMANN SPRUCE BEETLE CONDITIONS IN THE SPRUCE STANDS OF FOREST SERVICE REGION 4

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R. I. Washburn and J. A. E. Knopf, Entomologists

DIVISION OF FOREST INSECT RESEARCH
INTERMOUNTAIN FOREST AND RANGE EXPERIMENT STATION
Reed W. Bailey, Director
Forest Service
U. S. Department of Agriculture
Ogden, Utah

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ENGELMANN SPRUCE BEETLE CONDITIONS IN THE SPRUCE STANDS OF FOREST SERVICE REGION 4

By

R. I. Washburn and J. A. E. Knopf - Entomologists

INTRODUCTION

The Engelmann spruce beetle, Dendroctonus engelmanni Hopk., has long been recognized as a serious pest of Engelmann spruce in U. S. Forest Service Region 4. One of the earliest published accounts of an infestation in Region 4 concerns a 1905 infestation on the Manti National Forest in Utah.[1/] Since that time many other destructive outbreaks have occurred in the mature and overmature stands of the region. Probably the most serious took place in the mid-twenties on Boulder Mountain and Aquarius Plateau in southern Utah. This outbreak was responsible for the destruction of over 90 percent of the mature spruce timber on approximately 65,000 acres.

A large proportion of the region's spruce type grows at the higher elevations and until recently was relatively inaccessible. For this reason the spruce resource, to a certain extent, has received little attention. During the last few years many spruce areas have been made accessible, primarily through an accelerated access road program, and consequently logging of spruce timber has increased considerably. Recognizing that old inventory statistics for spruce type, as well as many other species, were not accurate, National Forest Administration is currently producing more accurate up-to-date volume and acreage figures through its timber survey program. Preliminary estimates, based on partially completed surveys, show the region has at least 1.5 million acres of commercial spruce type which contains somewhat over 10 billion board feet of Engelmann spruce. Since the spruce areas have become more accessible and more reliable estimates of acreages and volumes are available, it has become quite apparent that Engelmann spruce is an important and valuable timber species in the region. With a majority of the spruce in older age classes, protection against the Engelmann spruce beetle becomes an important factor in the management of spruce in Region 4.

This report is an effort to bring together the essential information concerning the outbreaks now active in the region. A map of Region 4 showing the relative position of the infestations, with more detailed maps of each infestation is appended.

1/ HOPKINS, A. D. The Genus Dendroctonus. U. S. Dept. Agr. Bul. No. 83, Part I, 1909.

PAYETTE NATIONAL FOREST

Fisher Creek. On July 28, 1958, the Payette National Forest notified the Division of Forest Insect Research of possible Engelmann spruce beetle build-up in the vicinity of the Fisher Creek timber sale which lies within the heart of the spruce type on the Payette National Forest. Early in August, R. I. Washburn and W. E. Cole visited the area and made a biological evaluation of the situation.

An active infestation of Engelmann spruce beetle was found in the upper 7 miles of Fisher Creek. It was estimated that about 2,000 trees were infested, the majority of which were located within the sale area, with a few scattered throughout the drainage. Evidence showed the beetles build up in slash and cull logs originating from sales that had recently become inactive. A few windthrown trees were located in the sale areas and along the edges of the fall fire which may have contributed some to the buildup, but it appeared that logging debris was a primary factor in the development of the infestation.

Both 1- and 2-year generation strains were present with considerable overlapping in the 2-year strain. Trees attacked in 1956 by the 2-year strain contained callow and mature adults as well as a few pupae. Some adults had already emerged and dropped to the base of the infested trees to hibernate. Some trees attacked by 2-year strain in 1957 were fading, and many showed evidence of woodpecker activity. These trees contained half-grown to nearly mature larvae. The majority of eggs had hatched within the trees newly attacked. New attacks by 1-year strain on standing trees averaged 3.5 to 4 per one-half square foot of bark surface; 7 attacks per one-half square foot occurred on slash. No evidence of parasites was found during the sampling.

Payette National Forest personnel were briefed on the entomologists' interpretation of the infestation immediately after completion of the examination. They were advised that the Engelmann spruce beetle could be expected to increase its activity in the Fisher Creek drainage, and that losses could be held to a minimum by taking immediate control action.

By the end of the field season all merchantable infested trees had been logged and plans formulated for the treatment of unmerchantable infested material.

BRIDGER NATIONAL FOREST

Gypsum Creek. Annual aerial detection surveys in the fall of 1955 revealed a serious outbreak of Engelmann spruce beetle on the Bridger National Forest, Wyoming. This infestation located on Gypsum Creek on the Green River drainage originally involved over 36,000 infested trees on about 24,000 acres. Since that time a program utilizing the following methods of control has been in effect:

1. Logging merchantable infested trees.
2. Felling trees to serve as traps.
3. Chemical treatment of infested stumps and slash.
4. Logging or treatment of infested traps.

To date these methods have contained the infestation to the point that practically all surrounding stands of spruce have escaped attack. Effective execution of these combined methods has been important in deterring population spread.

Examinations conducted by Station entomologists during 1958 revealed that spruce bark beetle populations are decreasing within the infested area. This is credited to control operations.

Roaring Fork. The Roaring Fork drainage, located approximately 4 air miles to the northeast of the main body of the Bridger infestation, contains considerable Engelmann spruce timber. Aerial observations during the 1958 fall surveys revealed several areas of fading spruce timber. Ground checks made on October 15 indicated that tree discoloration was not caused by Engelmann spruce bark beetle. Approximately 200 trees showing attacks by the spruce beetle were noted but these represented no more than the expected endemic population in the mature and overmature spruce which characterizes the drainage.

DIXIE NATIONAL FOREST

Griffin Springs. The Aquarius Plateau and Boulder Mountain areas of the Dixie National Forest have a long history of Engelmann spruce beetle outbreaks, the most recent of which occurred in 1952. Since that time populations have stayed more or less at endemic levels, but with the advent of increased logging activity in 1955 attractive breeding materials, consisting of stumps and slash, was available to the insect. Until spring flights in 1958, logging debris had absorbed the increasing beetle populations. Each year sufficient logging debris was laid down next to the previous year's sale area to absorb the beetle population and no standing trees suffered. In 1957 immediately adjoining one area previously logged, a heavy population of Engelmann spruce beetle emerged from downed material and since logging had ceased they attacked standing trees. Station entomologists estimated that there was approximately 3,000 infested trees on an area of about 700 acres. Immediate control measures were initiated which included both logging and chemical treatment. Further controls for 1959 are not anticipated; however, the area will be kept under close surveillance.

MOAB UTAH AREA

Dark Canyon. The Engelmann spruce beetle has been developing in logging slash and windthrows in the mature Engelmann spruce stand on the east side of Mt. Peale in southeastern Utah for the last three or four years. By the fall of 1957 the beetle population had increased to a point that downed and weakened material could no longer absorb all the beetle population. Consequently, large numbers of standing spruce were successfully attacked. The presence of spruce beetle in epidemic numbers was detected and reported by State land board employees through the State Board of Forestry and Fire Control. The infestation occurs on the Manti-LaSal National Forest, State of Utah holdings, and privately owned lands.

Biological evaluation of the infestation as made on July 14-15 by Station entomologists,[2/] plus subsequent examinations or surveys, showed that in July over 7,000 trees were infested on about 1,000 acres.

The examination revealed the epidemic was a result of several years of gradual accumulative buildup in logging slash and windthrow. This was possible primarily because the spruce had been cut on a tree-selection basis which caused much of the slash to be shaded. As usual, in a cutting of this type, some blowdown occurred. The bark beetle population, brood development, and predator-parasite host relationship was typical of epidemic conditions.

Control operations in the form of logging and chemical treatment of infested material was carried out this fall with a resultant reduction in beetle population. However, with approximately 5,500 infested trees remaining, there is still a serious threat to the spruce timber in the infested area as well as large bodies of adjoining spruce type.

UINTA - ASHLEY - WASATCH NATIONAL FORESTS

Soapstone Project. During the past three years a buildup of Engelmann spruce beetle has been occurring on the Uinta, Ashley, and Wasatch National Forests.[3/] The majority of the infestation is centered in the high country of the Uinta National Forest. Population increases apparently started in light, widely scattered windfall and slash from logging operations. There is evidence that

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2/ WASHBURN, R. I., and J. A. E. KNOPF. Engelmann spruce beetle conditions, Manti-LaSal National Forest and adjoining lands. Appraisal survey. Intermountain Forest and Range Experiment Station. 3 pp. (Processed) 1958.

3/ WASHBURN, R. I., and J. A. E. KNOPF. Engelmann spruce beetle conditions Uinta, Ashley, Wasatch National Forests. Appraisal survey. Intermountain Forest and Range Experiment Station. 3 pp. (Processed) 1958.

standing trees were not attacked to any extent until the fall of 1957. A buildup of this type is not spectacular and often goes undetected until standing trees, which are more readily observed, are infested.

On the morning of June 30, 1958, a detection report was received that Engelmann spruce beetle was active in the Wolf Creek, Soapstone basin, and South Fork of the Provo River areas. Plans were made immediately for an aerial inspection of the areas. The inspection confirmed initial reports of bark beetle activity and a considerable area of probable infestation was delineated on the flight map.

On July 2, 1958, a ground inspection of the Wolf Creek and Dry Hollow Ridge areas was made. The purpose of the trip was to locate several of the infestation sites that had been observed from the air, to make preliminary biological evaluations of these areas, and to formulate action plans for a more complete appraisal of the situation.

Two areas of spruce within Soapstone Basin were given high priority and plans formulated so that logging operations could be initiated promptly. Accelerated surveys resulted in an estimate of 3,700 attacked trees in the Cold Springs area and a total of 350 heavily hit trees on one small patch of spruce on Soapstone Creek. Forest personnel supplied with these survey data were able to contact logging operators and issue sale contracts. Cutting operations of the infested timber were started July 10. Surveys conducted July 7 through 11 covered approximately 160 square miles. Within this area it was determined that the present infestation covers about 45 square miles and contains over 67,000 trees currently infested. The spruce timber in the infested area falls primarily in larger diameter classes, over 20 inches DBH, and of 5 or more logs in height.

Biological data pointed out the fact that the Soapstone Basin infestation was a relatively new epidemic with the potential of denuding portions of three national forests and a high value wilderness area of their Engelmann spruce cover. Findings from the biological examinations were as follows:

1. Most overwintering adults had emerged and were in the process of making new attacks. (July)

2. Approximately 40 percent of the infested trees containing brood were new attacks, while 60 percent of the trees had been attacked in 1957. Newly attacked trees had a relatively high level of egg deposition.

3. Trees attacked in 1957 were noted as having half-grown to mature larvae, pupae, and callow adults. The ratio was about three trees containing larvae to every tree with pupae and callow adults. (July)

Throughout the old attacks there was considerable overlap of growth stages which indicated that both 1- and 2-year life cycle broods were present in the beetle population.

4. A conspicuous lack of parasites and predators was noted throughout the infestation.

5. Woodpecker activity in some limited areas was classified as moderate to heavy with the existing population of woodpeckers showing a decided preference for certain trees. For the total infested area, however, woodpecker activity was considered as light.

In addition to Soapstone Basin, several pockets of infested spruce timber were located along the perimeter of the main infestation. These areas represent centers from which the beetles could spread. Following is a list of the more important fringe infestations:

High Uinta Wilderness: At present, an estimated 25 square miles in the High Uinta Wilderness Area are lightly infested. Actually, Engelmann spruce stands constitute a small percentage of the total type in the wilderness. The greater portion of the trees in the Granddaddy Lakes Basin are lodgepole pine while most of the spruce occurs around the edge of lakes and in close association with creek bottoms and draws. Observations indicate that the present infestation is at a high endemic level and could become epidemic or possibly revert to a lower endemic population.

Trees in each group were examined for brood development. Most infested trees examined were supporting moderate broods but a few trees contained heavy broods.

Further examinations revealed a fairly high population of parasites in the larval galleries. The majority of parasites observed were dipterous. A small number of hymenopterous parasites of the family Braconidae were also found. If present infestations should kill wilderness spruce stands, the aesthetic values of the area would be greatly impaired.

Hades Canyon: In Hades Canyon the infestation starts below Splash Dam and runs up the canyon to the timber line. Hades Canyon leads into the wilderness area near the Granddaddy Lakes. Infested trees sampled showed epidemic populations and a decided lack of parasites.

Swift Creek: Examinations showed groups of 1957 and 1958 attacks in trees occurring throughout Swift Creek. Brood densities were classed as light to moderate; however, a few trees were found that were supporting heavy broods. Hymenopterous and dipterous parasites were found in light numbers. Woodpecker work was classed as light to moderate.

Evans Draw: This represents the heaviest attack area in all drainages examined. 1957 saw large numbers of trees attacked and in 1958 the remainder of this island of spruce was heavily hit. It was estimated that about 70 percent of the stand had been killed or was infested. An old blowdown was present at the head of the draw and was no doubt greatly responsible for development of the infestation. Parasites and predators were abundant. Examination of the blowdown and killed trees and evaluation of heavy populations of natural enemies indicated that the infestation was several years old.

Lake Basin, Blind Stream, South Fork Rock Creek: Engelmann spruce stands in the three areas are supporting epidemic populations of beetles. Attacks were occurring in moderate to large groups of trees with populations that indicated increasing trends. Predators and parasites were in evidence throughout all areas with the majority of parasites belonging to the order Diptera. Woodpecker work was light but a few groups of trees show moderate to heavy work.

Mill Hollow: On July 30, a thorough ground reconnaissance was made in the Mill Hollow drainage to obtain information regarding spruce bark beetle conditions. Results of this check are as follows:

1. Estimates show approximately 500 infested trees occurring as scattered groups throughout the area. Some groups occurred on steep slopes and along rocky ledges where logging cannot be carried out. These groups will have to be chemically treated to be controlled. Other groups were in readily accessible locations.

2. There was a low incidence of new attacks.

3. Broods consisted, at the time, of mostly mature larvae and new pupae. Very few callow adults were found indicating a low level of 1-year generation beetles.

4. Recent logging operations have left green stumps and tops scattered throughout the upper Mill Hollow area. A close check should be kept on these stumps and tops for they may act as traps.

Harvey Meadows, Yellow Lake: In the west fork of the Duchesne River drainage two areas, Harvey Meadows and Yellow Lake, were checked for Engelmann spruce beetle activity. No major infestation areas were located and beetle populations were at a low level. These areas, however, are in close proximity to the Wolf Creek drainage and should be kept under close surveillance to detect any increased beetle activity.

Upper Provo River: In the upper reaches of this drainage, principally in the vicinity of Mirror Lake, a highly used recreational area, several hundred overmature spruce trees were attacked in 1957 and 1958. Wasatch National Forest personnel marked and spotted the majority of infested spruce timber.

Logging and chemical control measures were undertaken to reduce the threat of continued spread of the beetle. At the termination of the 1958 control activities, over 1,000 trees had been logged.

Control Operations
Uinta - Ashley - Wasatch Project

Logging of infested trees began within six days of receipt of the first detection report. Logging and chemical treatment were carried on until mid-October, at which time heavy snows made it impractical to continue.

At the termination of this year's activities, over 12 MM board feet of infested timber had been logged. In addition, over 32,000 "units" had been treated with ethylene dibromide. (A unit consists of the stump and top of a felled tree.)

DISCUSSION AND RECOMMENDATIONS

This discussion of the present Engelmann spruce beetle situation in the Region 4 territory should serve to alert all forest workers to the potential seriousness of bark beetle activity in spruce stands. It also provides background data necessary for planning and conducting any control programs that are undertaken.

Evaluation of data from each area provides an opportunity to make certain comparisons between the outbreaks. It did not appear valid to include in the comparison the Bridger National Forest infestation which is several years old and has been subjected to treatment. Therefore, the following statements refer only to outbreaks reported for the first time in 1958:

1. All infestations are relatively new with 1957 being the first year that many standing trees were attacked.

2. Nearly all new infestations developed in or near areas of recent logging activity.

3. The initial "buildup" in nearly all epidemic centers appears to have taken place in logging slash, stumps, and scattered windthrow, usually located within the sale area.

4. In some epidemic areas, logging had been active almost continuously for as long as 10 years, while in others logging was more recent, and of a shorter duration.

5. There appeared to be no relationship of major climatic conditions for the period 1955-1957 to infestation status in various areas, i. e., some areas have had more than normal moisture; others less--some have had one or more winters with severe temperatures,

others were warmer than usual--still other epidemic areas have had near normal summer and winter climates.

5. In all infestations the beetles show a definite preference for the larger diameter trees.

7. Biologically, nearly all epidemic centers were similar to this extent:

   a. Bark beetle brood densities were heavy.
   b. There was a decided lack of obvious insect predators and parasites.
   c. Woodpecker activity was light.
   d. Egg deposition per inch of gallery exceeded that recorded by Massey[4/] for the Colorado epidemic.
   e. Both 1- and 2-year generation strains were present in all epidemic areas.

On the basis of these comparisons, certain conclusions can be drawn as follows:

The buildup to epidemic status of most of these new outbreaks is directly related to recent logging of spruce timber, most of which was done on a tree-selection basis, where considerable slash remained in shade. It is to be recognized that outbreaks do not always develop under these circumstances but these conditions are favorable. This being the case, it would seem desirable to analyze cutting practices in an effort to develop ways to minimize opportunity for bark beetle buildup. To do this requires a basic understanding of the host requirements and preferences of the spruce beetle. It is a known fact that Engelmann spruce beetles prefer down and weakened spruce timber, provided the material is green and suitable for attacks. It has also been shown conclusively that other factors being equal, down and weakened material will produce a larger population of beetles than an equal amount in standing green trees. Green material laid down in the shade remains suitable for beetle attack much longer than material exposed to the sun. In general, spruce trees are shallow-rooted and consequently not considered very wind firm. Obviously, spruce sales marked and cut on a tree-selection basis provide ample opportunity for logging residue to be laid down in the shade and often encourages windthrow and breakage of "leave" trees. On the other hand, when spruce is properly clear cut, a majority of the slash is exposed to the sun and the opportunity for wind damage is minimized. Therefore, it is believed that when protection from bark beetle damage is a major consideration, there is less danger in clear-cut blocks or strips. If for other reasons a selection cut is dictated, those concerned with the sale should be fully aware that a bark beetle epidemic could develop.

4/ MASSEY, C. L., and WYGANT, N. D. Biology and control of the Engelmann spruce beetle in Colorado. U. S. Dept. Agr. Cir. No. 944. 1954.

All areas presently infested, with the exception of Roaring River on the Bridger National Forest, are at epidemic levels and will, in all probability, continue to increase in severity if left to run their normal course.

Application of control measures appears to be necessary in each case if spruce losses are to be held at a minimum. At present there are three basic treatments that can be utilized to reduce spruce beetle populations:

1. Removal of infested trees and logs by logging.

2. Application of toxic chemicals on infested trees, etc.

3. In conjunction with 1 and 2, "trap trees" can be utilized. Properly placed they attract large numbers of beetles that can be destroyed by logging or chemical treatment.

Control operations directed against Engelmann spruce beetle outbreaks are usually complicated by the presence of 1- and 2-year broods and other variations in the development of insect populations. Efforts by the forest manager are dependent upon these entomological considerations and programs are adjusted to fit the particular situation. This is being effected by close cooperation between the forest manager and the entomologist for each of the infestations described in this report.

U. S. FOREST SERVICE
REGION 4

Relative Positions Of Engelmann Spruce Beetle Infestations, 1958

LEGEND

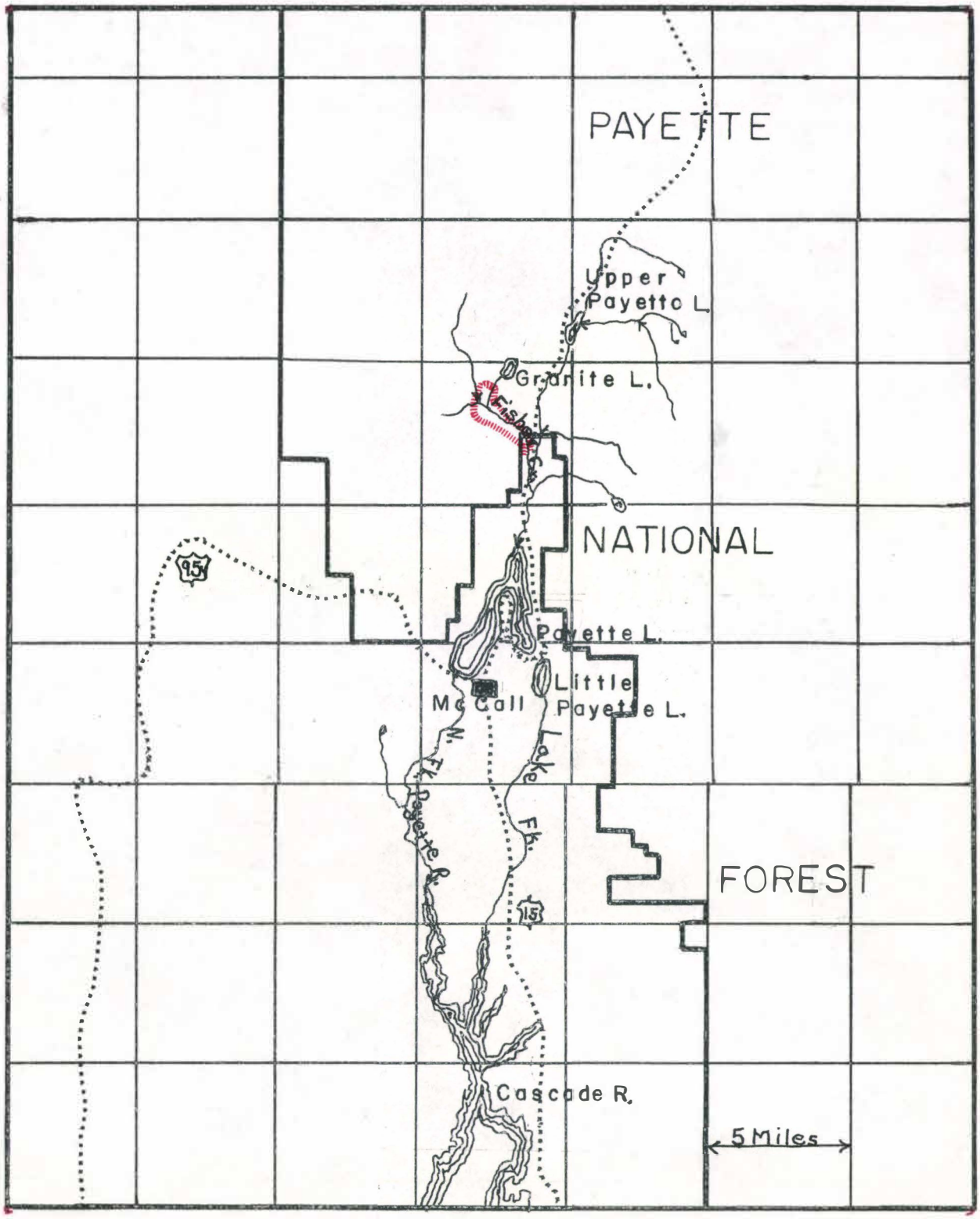
DRAINAGES

INFESTATION BOUNDARIES

ROADS

NOTE

INDIVIDUAL MAPS VARY AS TO SCALE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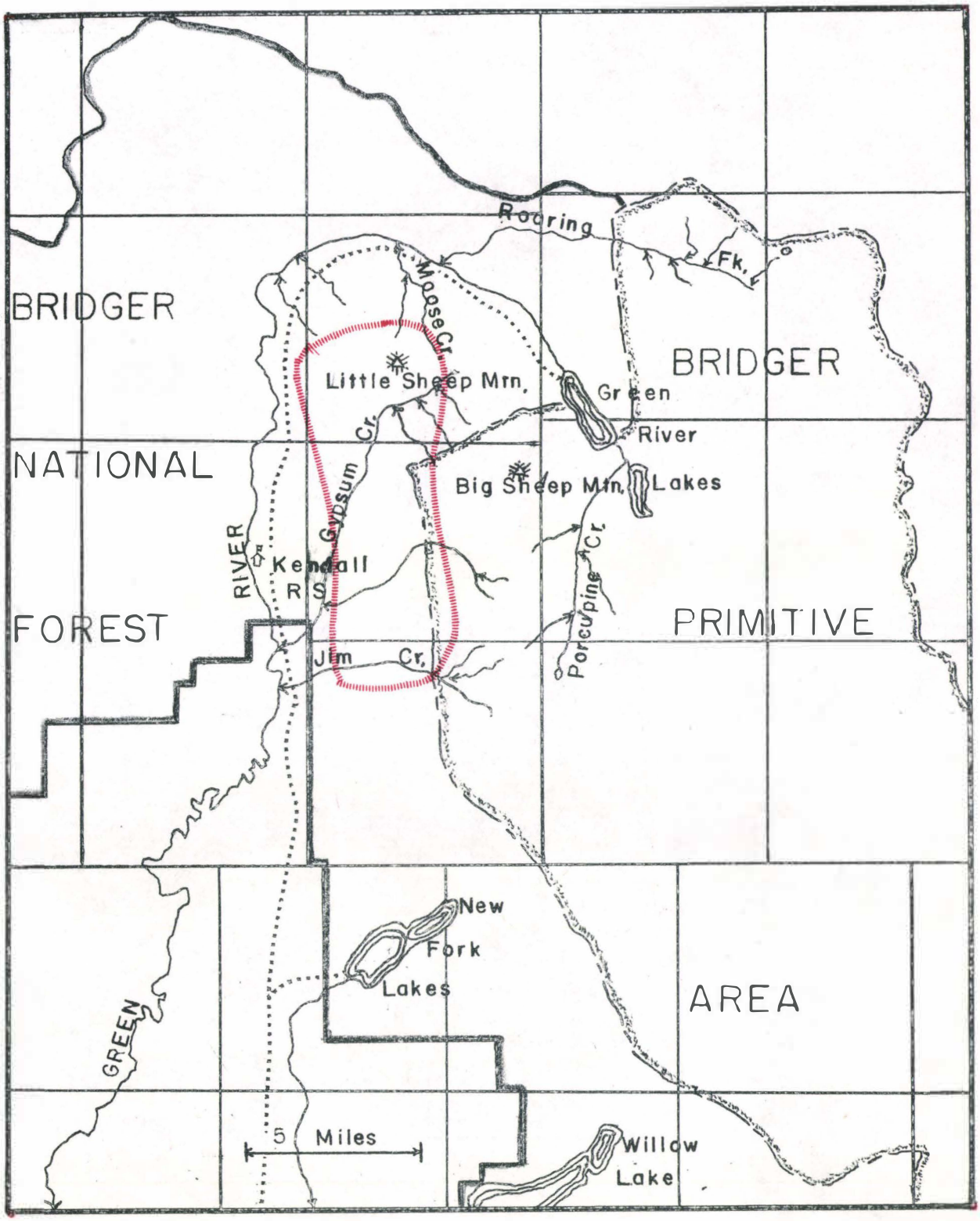
FOREST
Cascade R.
5 Miles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BRIDGER
PRIMITIVE
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Green River
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RIVER
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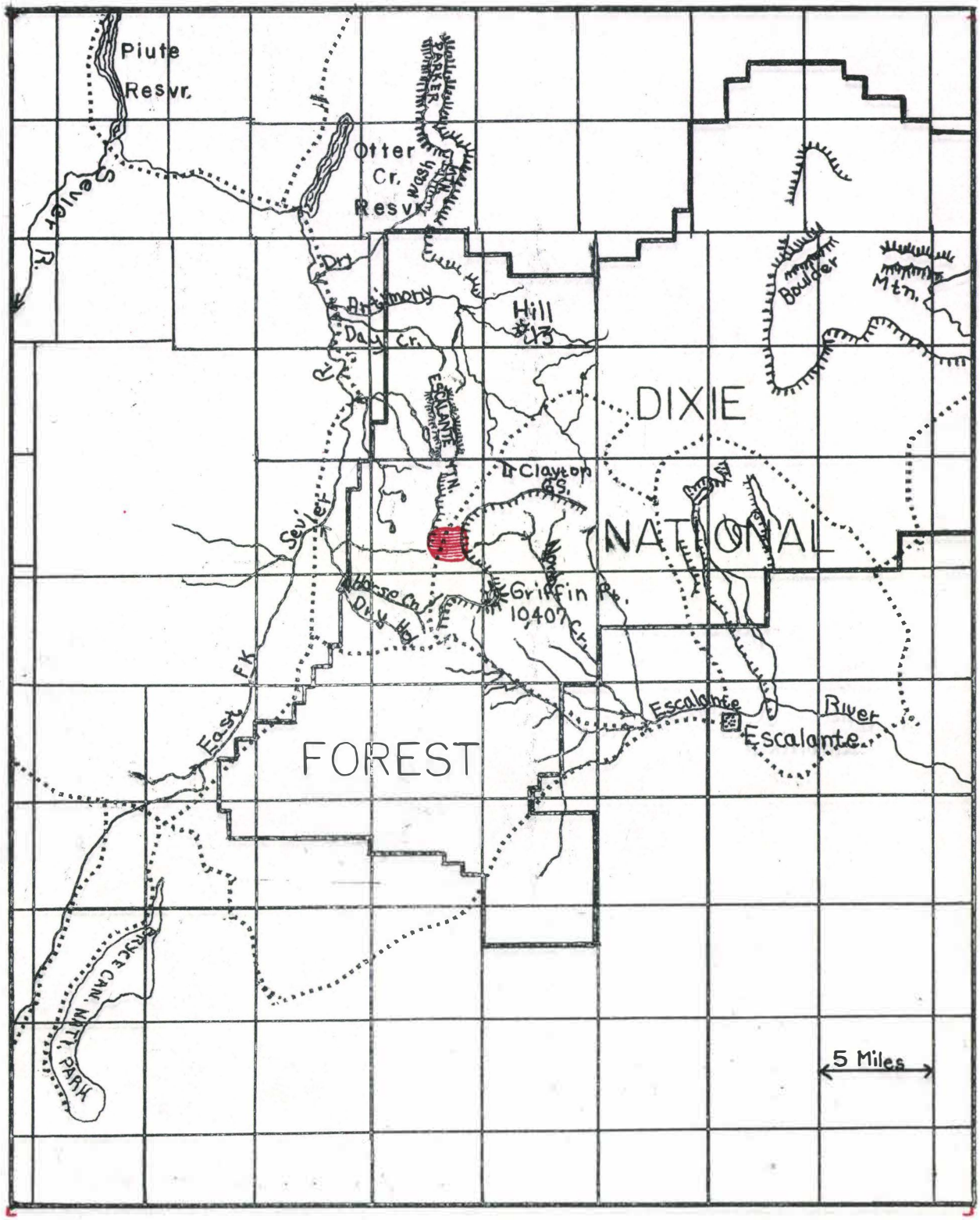
Porcupine Cr.
Jim Cr.
New Fork Lakes
GREEN
5 Miles
Willow Lake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Clayton
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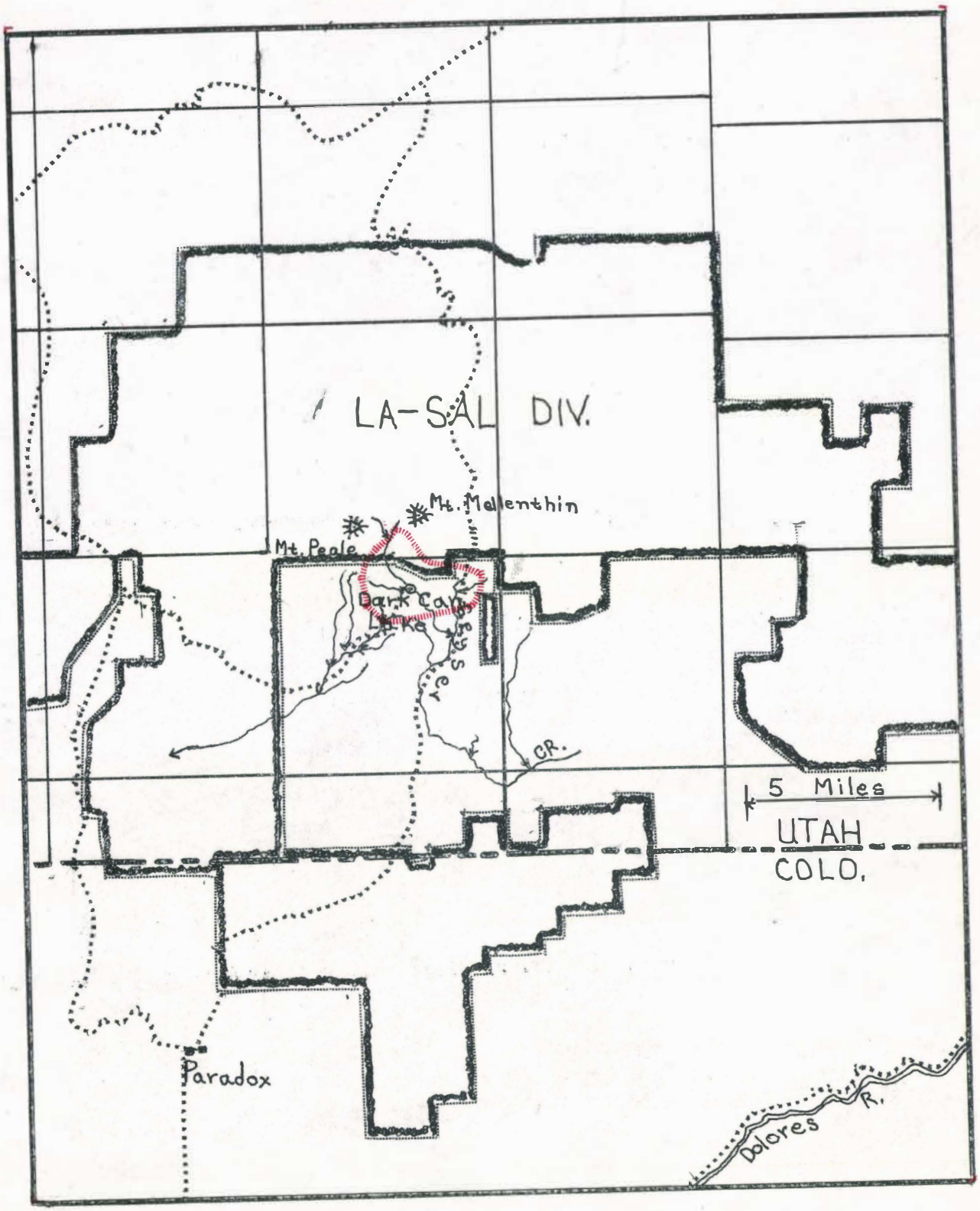
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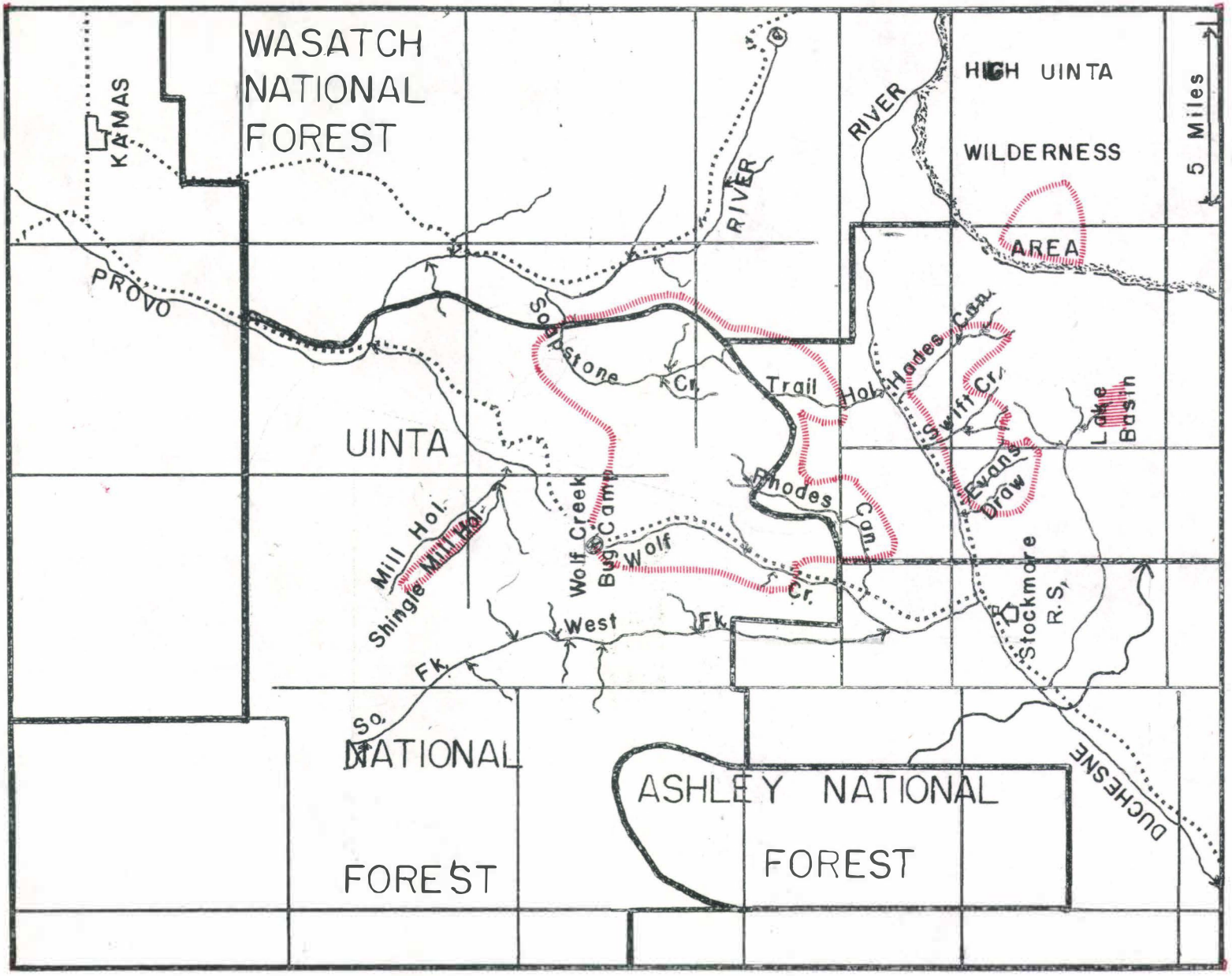
COLO.
Paradox
Dolores R.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Mill Hol.
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Wolf Creek
Bug Camp
Wolf
Cr.
West
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Stockmore
R.S.
DUCHESNE
NATIONAL
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ASHLEY NATIONAL
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FOREST SERVICE
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